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course at Harvard devotes about thirty periods to analytic geometry and the material consists of the essential parts of the first nine chapters. Another freshman course gives twice the time to analytic geometry (the students having already had trigonometry), taking up determinants and the descriptive properties of the quadric surfaces, and also devoting more time to the less elementary applications of the methods of analytic geometry. The advanced courses in the calculus and mechanics require the material of the later chapters. In fact, a thorough elementary treatment of the rudiments of Solid Analytic Geometry is indispensable for the understanding of standard texts on applied mathematics. It is true that these texts are chiefly Continental. But we shall never have American treatises which are up to the best scientific standards of the day until the subjects above mentioned are available in simply intelligible form for the undergraduate.

"The subject of loci is brought in early through a brief introductory chapter, and problems in loci are spread throughout the book. A later chapter is devoted to a careful explanation of the method of auxiliary variables. There is a chapter on determinants, with applications both to analytic geometry and to linear equations. Diameters and poles and polars in the plane and in space receive a thorough treatment. Cylindrical and spherical coördinates and quadric surfaces are illumined by the concept of triply orthogonal systems of surfaces. The reduction of the general equation of the second degree in space to normal forms by translations and rotations is sketched and illustrated by numerical examples.

"The question may be asked: In so extensive a treatment of analytic geometry should not, for example, homogeneous coördinates find a place? The authors believe that the student, before proceeding to the elaborate methods of modern geometry, should have a thorough knowledge both of the material and the methods which may fairly be called elementary, and they felt that a book which, avoiding the conciseness of some of the current texts and the looseness of others, is clear because it is rigorous will meet a real need.

"This book is designed to be at once an introduction to the subject and a handbook of the elements. May it serve alike the needs of the future specialist in geometry, the analyst, the mathematical physicist, and the engineer."

Contents. *Plane analytic geometry*—Introduction: Directed line-segments. Projections, 1–6; Chapter I: Coördinates. Curves and equations, 7–26; II: The straight line, 27–52; III: Applications, 53–64; IV: The circle, 65–78; V: Introductory problems in loci. Symmetry of curves, 79–87; VI: The parabola, 88–100; VII: The ellipse, 101–123; VIII: The hyperbola, 124–153; IX: Certain general methods, 154–192; X: Polar coördinates, 193–215; XI: Transformation of coördinates, 216–234; XII: The general equation of the second degree, 235–260; XIII: A second chapter on loci. Auxiliary variables. Inequalities, 261–287; XIV: Diameters. Poles and polars, 288–329; XV: Transformations of the plane. Strain, 330–359; XVI: Determinants and their applications, 360–404. *Solid analytic geometry*—Chapter XVII: Projections. Coördinates, 405–420; XVIII: Direction cosines. Direction components, 420–443; XIX: The plane, 444–469; XX: The straight line, 470–497; XXI: The plane and the straight line. Advanced methods, 498–522; XXII: Spheres, cylinders, cones. Surfaces of revolution, 523–547; XXIII: Quadric surfaces, 548–583; XXIV: Spherical and cylindrical coördinates. Transformation of coördinates, 584–606; Index, 607–614.

Einstein's Theories of Relativity and Gravitation. A Selection of Material from the Essays submitted in the Competition for the Eugene Higgins Prize of $5,000. Compiled and edited, and introductory matter supplied, by J. M. BIRD, associate editor of the *Scientific American*. New York, Scientific American Publishing Co., 1921. 12mo. 14 + 345 pp. Price $2.00.

We have already referred [*1921*, 191–192; 269] to the prize offered by the *Scientific American*, to the conditions of its award, and to essays presented in competition for it. In the volume under review the prize essay is not given till pages 169–180 and this is followed by a dozen other essays. It was designed by the editor that "Each essay should be made easier of reading by the examination of those preceding it; at the same time each, by the choice of ground covered and by the emphasis on points not brought out sharply by its predecessors, should throw new light upon these predecessors." Chapters II–VI, pages 19–

168, are given up to the discussion of various ideas for making the reading of the essays more profitable; for this purpose, in three of these chapters, the general plan has been to make extracts from about fifty other of the competing essays, the extracts being connected by editorial comment. For example, in the chapter on "The special theory of relativity" there are extracts from competing essays of twenty-six authors, interlarded with more than twenty-five editorial comments. The following is the complete table of contents:

Preface, iii–xii; Chapter I: The Einstein $5,000 prize: how the contest came to be held, and some of the details of its conduct, by the editor, 1–18; II: The world—and us: an introductory discussion of the philosophy of relativity, and of the mechanism of our contact with time and space, by various contributors and the editor, 19–46; III: The relativity of uniform motion: classical ideas on the subject; the ether and the apparent possibility of absolute motion; the Michelson-Morley experiment and the final negation of this possibility, by various contributors and the editor, 47–75; IV: The special theory of relativity: what Einstein's study of uniform motion tells us about time and space and the nature of the external reality, by various contributors and the editor, 76–110; V: The parallel postulate: modern geometric methods; the dividing line between Euclidean and non-euclidean; and the significance of the latter, by the editor, 111–140; VI: The space-time continuum: Minkowski's world of events, and the way in which it fits into Einstein's structure, by the editor and a few contributors, 141–168; VII: Relativity: the winning essay in the contest for the Eugene Higgins $5,000 prize, by Lyndon Bolton, British Patent Office, London, 169–180; VIII: The new concepts of time and space: the essay in behalf of which the greatest number of dissenting opinions have been recorded, by Montgomery Francis, New York, 181–194; IX: The principle of relativity: a statement of what it is all about, in ideas of one syllable, by Hugh Elliot, Chiselhurst, Kent, England, 195–205; X: Space, time and gravitation: an outline of Einstein's theory of general relativity, by W. de Sitter, University of Leyden, 206–217; XI: The principle of general relativity: how Einstein, to a degree never before equalled, isolates the external reality from the observer's contribution, by E. T. Bell, University of Washington, 218–229; XII: Force vs. geometry: how Einstein has substituted the second for the first in connection with the cause of gravitation, by Saul Dushman, Schenectady, 230–239; XIII: An introduction to relativity: a treatment in which the mathematical connections of Einstein's work are brought out more strongly and more successfully than usual in a popular explanation, by Harold T. Davis, University of Wisconsin, 240–250; XIV: New concepts for old: what the world looks like after Einstein has had his way with it, by John G. McHardy, Commander R. N., London, 251–264; XV: The new world: a universe in which geometry takes the place of physics, and curvature that of force, by George Frederick Hemens, M.C., B.Sc., London, 265–275; XVI: The quest of the absolute: modern developments in theoretical physics, and the climax supplied by Einstein, by Dr. Francis D. Murnaghan [*1921*, 269], Johns Hopkins University, Baltimore, 276–286; XVII: The physical side of relativity: the immediate contacts between Einstein's theories and current physics and astronomy, by Professor William H. Pickering, Harvard College Observatory, Mandeville, Jamaica, 287–305; XVIII: The practical significance of relativity: the best discussion of the special theory among all the competing essays, by Prof. Henry Norris Russell, Princeton University, 306–317; XIX: Einstein's theory of relativity: a simple explanation of his postulates and their consequences, by T. Royds, Kodaikanal Observatory, India, 318–326; XX: Einstein's theory of gravitation: the discussion of the general theory and its most important application, from the essay by Prof. W. F. G. Swann, University of Minnesota, Minneapolis, 327–333; XXI: The equivalence hypothesis: the discussion of this, with its difficulties and the manner in which Einstein has resolved them, from the Essay by Prof. E. N. da C. Andrade, Ordnance College, Woolwich, England, 334–337; XXII: The general theory: fragments of particular merit on this phase of the subject, by various contributors, 338–345.

An Introduction to Mathematical Analysis. By F. L. Griffin. Boston, Houghton, Mifflin Company, 1921. 12mo. 8 + 512 pp. Price $2.75.

Extracts from the Preface: "Under the traditional plan of studying trigonometry, college algebra, analytic geometry, and calculus separately, a student can form no conception of the character and possibilities of modern mathematics, nor of the relations of its several branches as parts of a unified whole, until he has taken several successive courses. Nor can he, early enough,